
Sample Midterm Exam

Your name:

Open Book and Notes

(27) 1. Network Flow

Suppose we have C factories which produce cars and R factories which produce trucks. Let c_i represent the number cars per month the i th car factory can produce, and similarly r_i for the r th truck factory.

We also have D dealers each of whom sells both cars and trucks. dc_i , dr_i represent the number of cars, trucks the i th dealer wants to receive each month.

Each factory has a list of the dealers it can send its output to (so can send to some but not all).

a) Describe an efficient scheme to determine how many cars and trucks each factory should send to each dealer. If possible we want to supply each dealer with the desired number of cars and trucks. (draw a picture to explain your solution)

b) analyze the run time of your algorithm in terms of C, R and D .

(19) 2. Suppose you have an array of n elements: ABCD where A,B,C,D represent consecutive blocks of a, b, c, d elements respectively (e.g. if A is the first 20 elements, $a = 20$).

We want to convert the array to: ADCB using only constant extra space.

a) Describe a simple scheme in terms of algorithms we have studied to convert the array to ADCB. You may use routines described in the book or class without describing their details.

b) What is the running time of your solution? (you may use big O notation in terms of the sizes n, a, b, c, d given).

(13) 3. Suppose you have an n vertex m node flow network G where all arcs have capacity 1 or 2. Argue that if we run the successive shortest augmenting paths algorithm we will get much better performance on this network than the general $O(mn^2)$ bound. State and justify your improved time bound for this setting.

(31) 4. In ps2 we used BFS to compute the shortest path from vertex 1 to all other vertices (number of hops). If our true goal was just to compute these distances suggest a way we could often greatly speed up the computation for dense graphs

(15) 5. For binary search we suggested various ways we could cross check to see our algorithm was working correctly. Suggest ways similar ways we could gain confidence network flow program for successive shortest augmenting paths was working correctly.